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Atmospheric Chemistry and Physics Discussions

Interactive comment on "In-situ physical and chemical characterization of the Eyjafjallajökull aerosol plume in the free troposphere over Italy" *by* S. Sandrini et al.

Anonymous Referee #1

Received and published: 20 September 2013

The paper is an interesting contribution to the substantive body of papers characterising Eyjafjallajokull eruption. There are two reasons why the paper may be of considerable interest to the readers: (1) evidence of the spatial extent and characterisation of the ash plume as far as the Apennines; (2) coupled with the quantitative assessment of the ash contribution to PM10 mass. The paper is generally well written and can be accepted for publication after addressing many but rather minor comments.

Implications for air quality should be considered along with the dilution effect when free tropospheric air mixes into the boundary layer. Dilution ratio of approximately 5 times (depending on the thickness of volcanic ash layer in the free troposphere and

the boundary layer height) would result in pretty negligible contribution to air quality at the ground level especially considering typical concentrations of several tens of micrograms m-3, e.g. in Po Valley region. The dilution issue is mentioned by the authors, but should be better articulated in the air quality section.

The other weak point of the study is an ambiguity when authors discuss volatility of species and their condensation onto existing particles. There are many instances of this ambiguity in the comments bellow, e.g. volatility of metals, condensation of sulphate (an oxymoron) or condensation of particles just to name a few.

Minor comments:

P20200, line 21. Mass attenuation cross section should be provided.

P20201, line 1. CPC range typo, should be 10^4, not 104 particles.

P20202, line 8. Change to "... especially around noon time during summer days...".

P20204, line 10. Replace "transfer" with "spread".

P20205, line 15-20. It is more appropriate to refer to HYSPLIT spatial uncertainty of 15-30% available on NOAA website, but authors are more or less correct in referring to 20% uncertainty.

Line 23. "typical regional background aerosol" otherwise the term background is misleading.

Line 25. Replace "normal" to "typical".

P20206, line 10. "...(ash particles) were able to stay airborne while being transported...".

Line 25. Specify typical concentrations in numbers when claiming significantly higher concentrations.

Line 27. Specify detection limit.

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P20207, line 23. Be more specific about applied correction.

Line 27. There was marked increase in accumulation mode particle diameter (volume increased only slightly), which implies that the number probably even decreased.

P20208, end of section 3.2. Make a summary statement that the event was a mixture of volcanic ash advection and anthropogenic pollution.

P20209-P20210. Why the percentiles are different as the values become hardly comparable?

P20210, line 4. What do you mean by “natural sources”? if volcanic, say it.

Line 14. Ammonium is a passive compound arising from ammonia emissions and pick-up by acidic particles. Degree of neutralisation does not allow distinguishing between volcanic and anthropogenic/agricultural ammonia. Nitrate origin is different and nitric acid is neutralised only after most of the sulphuric acid has been neutralised to ammonium (bi)/sulphate.

Line 19. Sulphate does not condense on the particles, sulphuric acid does.

Line 23. Ca-sulphates are most likely gypsum, either volcanic or formed en-route.

Line 24. Particles do not condense on pre-existing particles, they coagulate.

P20211, line 4. Not absorption, but adsorption/condensation. Line 14. “. . .and superimposed on regional anthropogenic pollution. . . “

P20213, line 22. Almost all metals are oxides (with very few exceptions like gaseous mercury (Hg2)) and are not volatile like gaseous compounds at lower temperatures. Some metalloids like As, Sb can form relatively volatile hydrates or thalium which resembles alkali metals and be considered relatively volatile opposite to generally non-volatile metal oxides. Zr, however, is not in either above category, so what was his source? Metals can be volatile at magma temperatures only at best and, therefore, in the rising plume only, not in the spread-out ash cloud. The reference to Andersson et

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al. is rather weak as authors are very speculative and ambiguous in that study. The most likely explanation is not volatility of those metals in question, but rather them forming nanoparticles in hot ash plumes which can then coagulate with similar size or larger particles in cooled ash cloud especially that many metal oxides particles can be wetted increasing their coagulation chances. Indeed, ash chemical composition determined in ash fallout may not be identical to the ash plume further away from the volcano and certain differences should be expected.

P20215, line 23. You indicate “very low”, but specify as being only twice lower – 73 versus 30ng/m3. Correct it.

P20216, line 25. “The Table exhibits high variability in such estimates arising from variability in the input parameters”.

P20217, line 10. “. . .with concurrent contributions of other than the volcanic source in April a different sites which are difficult to quantify”.

Line 12-17. Use past tense consistently as in the first sentence.

Line 23. Replace relative maximum” with “marked increase”.

P20219, line 5. “. . .degassed by the volcano and sulphuric acid subsequently condensed..”.

Line 14. “reconstructed PM10 mass”.

Line 16. “. . .were reported over Spain. . .

Table 1. “particle number concentrations”

Figure 1. Change Y axis to accumulation mode particle number. Same for “coarse”.

Figure 3. Change to accumulation mode N, #/cm3 and so on.

Figure 6. Y axis notation should be fixed – decimal points increased.

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